A deaf perſon not perfectly ſkilled in reading words from the lips, or who ſhould aſk any thing in the dark would be able to procure common information by putting various queſtions, and by telling the perſon that, as he is deaf, he requeſts anſwers by ſigns, which he will direct him to change according to circumſtances.—If he had loſt his way, if he enquired for any one, if he wanted to purchaſe any thing, and in all the common occurrences of life, his ſpeech would be ſo uſeful, that it would certainly more than repay the trouble of obtaining it; eſpecially as it would be a mode of facilitating every other acquirement.

WILLIAM THORNTON.

N°. XXXIV.

Obſervations on the Theory of Water-Mills, (continued from page 193) by W. WARING.

Read, April 5th 1793. SINCE the Philoſophical Society were pleaſed to favour my crude obſervations on the theory of mills with a publication in their tranſactions, I am apprehenſive ſome part thereof may probably be miſapplied.

It being therein demonſtrated, that, "the force of an invariable ſtream impinging againſt a mill-wheel in motion is in the ſimple direct ratio of the relative velocity," ſome may ſuppoſe, that the effect produced, ſhould be in the ſame proportion, and either fall into an error, or, finding by experiment, the effect to be as the ſquare of the velocity, conclude the new theory, to be not well founded; therefore, I wiſh there had been a little added to prevent ſuch a miſapplication, before the ſociety had been troubled with the reading of my paper on that ſubject; perhaps, ſomething like the following.

The

The maximum effect of an underſhot wheel, produced by a given quantity of water in a given time, is in the duplicate ratio of the velocity of the water. For the *effect* muſt be as the impetus acting on the wheel, multiplied into the velocity of the wheel. But this *impetus* is demonſtrated to be, ſimply, as the relative velocity, [Prop. 1. page 146] and the velocity of the wheel producing a maximum, being half that of the water, [by Prop. II. page 147.] is likewiſe as the velocity of the water: therefore, the power acting on the wheel multiplied into the wheel's velocity, or the effect produced, muſt be in the duplicate ratio of the velocity of the water. Q. E. D.

Corol. Hence the effect produced by a given quantity of water in a given time, will be as the height of the head, becauſe this height is as the ſquare of the velocity. This alſo agrees with experiment.

If the force acting on the wheel, were in the duplicate ratio of the water's velocity, as uſually aſſerted, then the effect would be as the cube thereof, when the quantity of water and time are given; which is contrary to the reſult of experiment.

When I attempted to compute the power, &c. of Doctor Barker's or James Rumſey's mill, as at page 185, the following ſimple demonſtration of its equivalence to that of the underſhot wheel, with the ſame quantity and fall of water, had not then occurred, viz.

Action and re-action are equal, &c.

But the underſhot wheel is propelled by the *action*, and the rotatory tube by the *re-action* of the ſame agent or momentum.

Therefore their mechanical effects muſt be equal.

The acting and counteracting forces which originate inſide the tube, not being from any external impulſe, can be no exception; becauſe, in any body, or ſyſtem of bodies, the

the mutual actions and reactions of the parts on each other do not alter the motion of their common centre of gravity. [Newt. Princip. B. 1. Law 3. and Corol. 4.]

Hence the increaſe of power from the centrifugal force, multiplied into the augmentation of velocity thereby occaſioned, juſt equals the force neceſſary to move the water into its ſpiral direction; which correſponds with what was before deduced from a different calculus.

Note under the head *Area of the Apertures*, page 192, the reſulting equation, which, by inadvertently uſing a for 2a, &c. is $\frac{AV}{8.924\sqrt{h}}$ ſhould be $\frac{AV}{18.47\sqrt{h}}$; and, of courſe, the number 8.924, in rule 4th page 193, ſhould be 18.47; but this overſight does not affect any other part of the calculation.

Philadelphia 4th 4mo. 1793.

Wm. WARING.

N°. XXXV.

An Improvement on metalic Conductors or Lightening-rods, in a Letter to Dr. DAVID RITTENHOUSE, *Preſident of the Society, from* ROBERT PATTERSON *of Philadelphia.*

☞ *This Paper was honoured with the Magellanic Premium, by an Award, of the Society in December* 1792.

SIR,

Read Nov. 5, 1790. FROM the inſtances which now and then occur of houſes being ſtruck with lightening, that are furniſhed with metalic conductors, and the frequent